

REMARKS

Claims 1-14 are pending in this application. Claim 5 has been withdrawn from consideration. By this Amendment, claims 1-5 are amended; and new claim 14 is added. Support for the amendments and the new claim can be found, for example, in the specification and claims as originally filed (see specification, page 11, lines 8-26; and Example 1). No new matter is added.

The courtesies extended to Applicants' representative by Examiner Crouse at the interview held on October 7, 2009 are appreciated. The reasons presented at the interview as warranting favorable action are incorporated into the remarks below, which constitute Applicants' record of the interview.

In view of the foregoing amendments and the following remarks, reconsideration and allowance are respectfully requested.

I. Rejections Under 35 U.S.C. §102

The Office Action rejects claims 1-4 and 6-13 under 35 U.S.C. §102(e) over U.S. Patent No. 7,098,060 to Yu et al. ("Yu"); rejects claims 1, 2, 6-10 and 13 under 35 U.S.C. §102(b) over U.S. Patent No. 6,066,357 to Tang et al. ("Tang '357") as further evidenced by U.S. Patent No. 4,769,292 to Tang et al. ("Tang '292"); rejects claims 1-4, 6, 7 and 10 under 35 U.S.C. §102(b) over U.S. Patent Application Publication No. 2002/0028349 to Seo ("Seo"); and rejects claims 1-4 and 6-13 under 35 U.S.C. §102(b) over EP 1,143,773 to Matsuo et al. ("Matsuo"). Applicants respectfully traverse the rejections.

By this Amendment, claims 1-4 are amended, with particular attention to the Examiner's comments set forth in the December 7, 2009 Advisory Action, to recite an electroluminescent element containing an unsubstituted π conjugated organic polymer compound, comprising, *inter alia*, "... a ... layer ... formed by causing gas molecules of at least one type of compound selected from the group consisting of dyes and charge transport

materials to contact and penetrate the unsubstituted π conjugated organic polymer compound by heating the unsubstituted π conjugated organic polymer compound and the at least one type of compound selected from the group consisting of dyes and charge transport materials in a thermostatic chamber."

For the reasons presented below, Applicants respectfully assert that Yu, Tang '357, Tang '292, Seo and Matsuo fail to disclose at least the above features of claims 1-4.

In general, unsubstituted π conjugated compounds exhibit poor doping ability and as a result, electroluminescent elements prepared with such compounds have relatively weak luminance and a luminescent color limited to the original color of fluorescence (specification, p. 3, line 27 – p. 4, line 4). However, an electroluminescent element containing a π conjugated organic polymer compound having significantly improved luminance and luminous efficiency can be achieved when prepared by the process recited in claims 1-4 (specification, p. 4, lines 7-25). More specifically, the process allows for gas molecules of dyes and/or charge transport materials to uniformly penetrate and diffuse the unsubstituted π conjugated organic polymer compound by heating the unsubstituted π conjugated organic polymer compound beforehand (specification, Example 1). As a result, the electroluminescent element exhibits vastly improved luminance and luminous efficiency when compared to existing devices prepared by methods disclosed in the applied references, and the claimed electroluminescent elements are further capable of emitting varying luminescent colors.

With reference to Yu, Tang '357, Tang '292, Seo and Matsuo: (1) Yu, Tang '357, Seo and Matsuo disclose an electroluminescent device prepared using a vapor deposition method (see Yu, col. 11, lines 28-57; Tang '357, col. 11, line 50 to col. 12, line 13; Seo, paragraph [0033]; Matsuo, paragraph [0248]; and Office Action, pages 3-6) and (2) Yu discloses an

electroluminescent device prepared using a spin coating method (Yu, col. 5 line 64 to col. 6, line 49). To support the differences between the electroluminescent element recited in the claims and the electroluminescent element of the applied references, Applicants hereby submit the Declaration Under 37 C.F.R. §1.132 ("Declaration") of Hiroyuki Mochizuki.

The Declaration describes experimental tests that were conducted with respect to electroluminescent devices prepared by the process steps recited in claims 1-4 in addition to various other processes known in the art and disclosed in applied references. Five electroluminescent devices were prepared: Example A and Comparative Examples A1-A4.

Example A was prepared using the method according to Example 1 recited in the specification (see specification, pages 11-12); Comparative Example A1 was prepared using a conventional spin coating method; Comparative Example A2 was prepared using only the contact and penetration method, recited in the specification (see specification, page 11); and Comparative Examples A3 and A4 were prepared using a vapor deposition method. With respect to Comparative Examples A1 and A2, the results show that an electroluminescent element could not be produced using a spin coating method (A1) or the contact and penetration method (A2).

With respect to preparing Comparative Example A3 using a vapor deposition method, a resin thin film (1 mm thick, 8 mm wide, 40 mm long) of PPV formed on a glass substrate, which had an ITO electrode, was inserted into a vacuum deposition apparatus. An electron transport compound 2-(4-biphenyl)-5-(4-tert-butylphenyl)-1,3,4-oxadiazole (PBD) was deposited on the PPV surface in thicknesses of 35 nm and 70 nm, using a deposition speed of 0.2 nm/second. Subsequently, silver and magnesium were deposited together to laminate a negative electrode, thereby producing an electroluinescent elements (see Fig. 1, below).

With respect to preparing Comparative Example A4 using vapor deposition, Comparative Example A4 was prepared in a similar manner to Comparative Example A3,

except that prior to laminating the negative electrode, cotton absorbed with acetone was placed in contact with the PBD surfaces of these samples. The PBD dissolved as a result of contact with the acetone, and, thus, the PBD was wiped off the surface of these samples. Because the PBD dissolved upon contact with acetone, the PPV surface of the samples had the same appearance as they did prior to depositing the PBD, i.e. the PBD did not penetrate the PPV layer (see Fig. 2, below).

After the acetone-wiped PPV surface was dried, silver and magnesium were deposited together to laminate a negative electrode, thereby producing an electroluminescent element (see Fig. 3, below). This electroluminescent element of Comparative Example A4 emitted yellowish green light, and had a maximum luminance of 19 cd/m^2 at 14V. The external quantum efficiency was 0.71 lm/w.

Furthermore, when the PPV surface on which PBD was deposited in the above-mentioned preparation was heated for two minutes at 110°C , condensation was observed on the surface. When the acetone-absorbed cotton was put into contact with the PBD surface of these samples, PBD was wiped off the surface of these samples. After wiping, these samples had the same PPV surface as existed prior to depositing PBD (see Fig. 2, below).

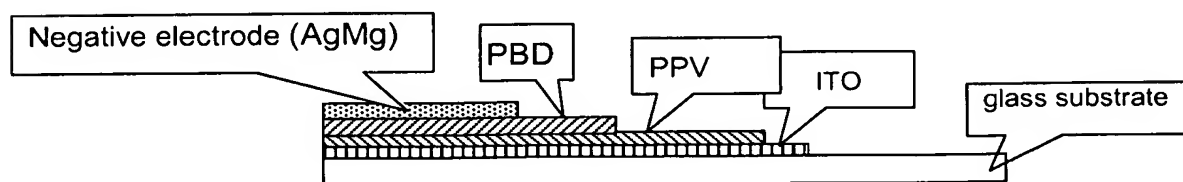


Fig. 1

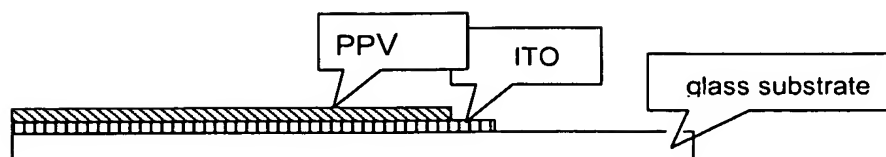


Fig. 2

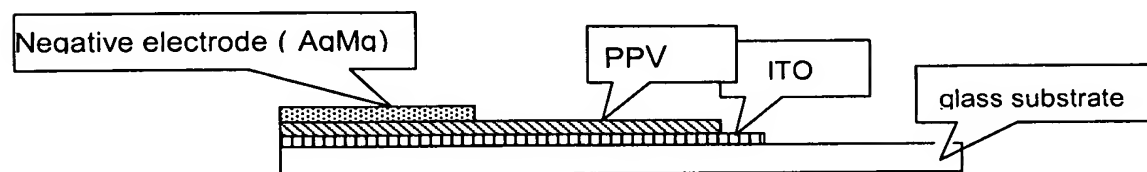


Fig. 3

The results of the experimental tests provided in the Declaration are summarized in as follows, with reference to Table 1 of the Declaration. When manufacturing or preparing an organic electroluminescent element using the unsubstituted π conjugated organic polymer compound PPV:

1. The **organic electroluminescent element could not be produced using**: (i) a traditional spin coating method (Comparative Example A1); or (ii) a contact and penetration method (Comparative Example A2).
2. With respect to the device prepared using a vapor deposition method (Comparative Examples A3 and A4), it was observed that even if PBD is deposited on PPV by vapor deposition, **PBD does not penetrate into the PPV layer**, and thus the **performance of the electroluminescent element deteriorates remarkably**. Further, the PBD that was wiped off after coming into contact with the acetone-absorbed cotton did not affect the efficiency of the electroluminescent device since it did not penetrate into the PPV layer.

In addition, compared to using a vapor deposition method, the product prepared by the process steps recited in claims 1-4 resulted in a **15,698.5% increase** in the measured maximum luminance and a **350.7% increase** in quantum efficiency over the vapor deposition method. These sizeable percent increases in the maximum luminance and quantum efficiency between electroluminescent devices prepared by the process steps of claims 1-4 and a vapor deposition method were vastly improved and distinguishable over the process steps recited in the applied references.

Accordingly, for at least the reasons set forth above, Applicants assert that the electroluminescent device prepared by the process steps recited in claims 1-4 are not disclosed by Yu, Tang '357, Tang '292, Seo and Matsuo and, thus, the applied references fail to anticipate claims 1-4, at least because the process steps recited in claims 1-4 impart significantly improved luminous characteristics that are not present in the electroluminescent devices disclosed in the applied references. The remaining claims variously depend from claim 1 and, thus, are also not anticipated by the applied references.

Accordingly, reconsideration and withdrawal of the rejections are respectfully requested.

II. Rejection Under 35 U.S.C. §103

The Office Action rejects claims 1-4, 6-9 and 13 under 35 U.S.C. §103(a) over U.S. Patent No. 6,313,261 to Samuel et al. ("Samuel") in view of Matsuo. Applicants respectfully traverse the rejection. The above discussion with respect to the rejections under §102 and the Declaration is incorporated herein by reference.

The Office Action concedes that Samuel fails to disclose diffusion of the dopant into the polymer layer and applies Matsuo to allegedly remedy the deficiencies of Samuel (Office Action, page 7). However, for at least the reasons set forth below, Applicants assert that

Samuel and Matsuo, as applied in the Office Action, fail to disclose and would not have rendered obvious at least the above features of claims 1-4.

As discussed above, Matsuo discloses an electroluminescent device prepared using a vapor deposition method (Matsuo, paragraph [0248]). With reference to the Declaration, Applicants' experimental results show that in comparison to a device prepared by the process steps recited in claims 1-4, a same device prepared using a vapor deposition methods resulted in a **99.4% decrease in maximum luminance, and a 77.8% decrease in quantum efficiency**. The Declaration clearly shows that electroluminescent devices prepared by the process steps recited in claims 1-4 have unexpectedly superior properties relative to similar devices made by other processes. None of the applied references provide any reason or rationale for one of ordinary skill in the art to have expected that by heating the unsubstituted π conjugated organic polymer compound and the at least one type of compound selected from the group consisting of dyes and charge transport materials in a thermostatic chamber wherein an inner temperature of 120°C was maintained for one hour, gas molecules of dyes and/or charge transport materials would uniformly penetrate and diffuse the unsubstituted π conjugated organic polymer compound, as shown in the enclosed Declaration, and thus one of ordinary skill in the art would not have expected the process steps of claims 1-4 to have yielded the vastly improved results shown in the Declaration.

Therefore, Applicants respectfully submit that claims 1-4 would not have been rendered obvious by Samuel and Matsuo, at least because the evidence presented in the Declaration establishes that the electroluminescent devices of claims 1-4 possess unexpected properties relative to the alleged disclosures of Samuel and Matsuo. The remaining claims variously depend from claim 1 and, thus, also would not have been obvious for at least the reasons set forth above.

Accordingly, reconsideration and withdrawal of the rejection are respectfully requested.

III. Rejoinder

Applicants also respectfully request rejoinder of non-elected method claim 5. Where product and process claims are presented in the same application, Applicants may be called upon under 35 U.S.C. §121 to elect claims to either the product or process. MPEP §821.04. However, in the case of an elected product claim, rejoinder will be permitted when a product claim is found allowable and the withdrawn process claim depends from or otherwise includes all the limitations of an allowed product claim. *Id.* Because process claim 5 include all the features of product claims 1-4, the process claims 5 must be rejoined with the product claims when the product claims are found allowable. Because the elected product claims are believed to be allowable for at least the reasons presented above, Applicants respectfully request withdrawal of the Restriction Requirement and rejoinder of claim 5.

IV. New Claim

By this Amendment, new claim 14 is added. New claim 14 depends from claim 1, and, thus, distinguishes over the applied references for at least the reasons discussed above with respect to claim 1, as well as for the additional features it recites. Prompt examination and allowance of new claim 14 are respectfully requested.

V. Conclusion

In view of the foregoing, it is respectfully submitted that this application is in condition for allowance. Favorable reconsideration and prompt allowance of the claims are earnestly solicited.

Should the Examiner believe that anything further would be desirable in order to place this application in even better condition for allowance, the Examiner is invited to contact the undersigned at the telephone number set forth below.

Respectfully submitted,



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JAO:SQL/scg

Attachments:

Petition for Extension of Time
Request for Continued Examination
Declaration Under 37 C.F.R. 1.132

Date: December 22, 2009

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